Remarks

Substitute Specification

The substitute specification is provided to conform the direct translation from German of the PCT application to proper English grammar and into the U.S. patent application format as specified in the MPEP. The amendments also correct direct reference in the written description of the specification to particular claim numbers (the substance of the claims has been read directly into the specification, replacing the claim numbers referenced.) No new matter has been added by these amendments.

Rejection of Claims 1-20 under 35 USC §103(a)

(a) Claims 1-20 were rejected under 35 USC §103(a) as unpatentable over Sternitzke[2] in view of Reed.[3]

The Action asserts that Sternitzke teaches all the elements of the presently claimed invention, except for the addition of sinter additives to the sol, which, the Action further asserts, is taught by Reed's suggestion of adding a small amount of a wetting liquid (*i.e.*, a sinter additive) to alumina during sintering to improve density and lower the temperature required for sintering.

(b) Independent claims 1 and 11

Claim 1, as amended, recites:

Method for the production of Al_2O_3/SiC nanocomposite abrasive grains, comprising the steps of:

mixing an aluminum-oxide containing sol with sinter additives and SiC nanoparticles to obtain a mixture; and

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[2] Review: Structural Ceramic Nanocomposites, *Structural Ceramic Composites-composites*, P11: So955-2219(96)00222-1, pp. 1061-1082, cited by the Applicants.

[3] Introduction to the Principles of Ceramic Processing, John Wiley and Sons, New York, New York, pp. 463-464, 1988.

subsequently gelling, drying, calcinating and sintering the mixture to obtain nanocomposite abrasive grains, the sintering being conducted by heating in the range between 1300°C and 1600°C.

Notably, the present invention has eliminated the hot-pressing densification step required by the methods taught by both Sternitzke and Reed to obtain effective abrasive grains. The instant Action indicates that section 2.1.3 of Sternitzke suggests Boehmite alumina as a starting material to make a gel to coat the SiC de-agglomerated particles. As stated in that section, however, "After drying and calcinations, the ultrafine powder is hot pressed..." Furthermore, in section 2.1.4 Sternitzke himself actually teaches away from processes not involving hot-pressing, "Such routes may be in conflict with the nanocomposite concept itself because grain growth and sinterability are drastically reduced by small inert particles..." and summarizes in section 2.2.1 that "Nanocomposites with considerably improved mechanical properties have, to date, *only* (emphasis added) been achieved in hot-pressed materials."

The instant Action points to page 463 of Reed for support in teaching adding a small amount (less than 1 vol%) of a "sinter additive" (*i.e.*, a wetting liquid) to alumina during sintering to improve density and lower the temperature required for sintering, referring to this liquid phase as a sinter additive. It is unclear that the silicate phase taught by Reed is a "sinter additive" in the sense of the present invention (*e.g.*, used to slow or stop crystal growth.) Reed's additive appears to comprise a glass phase that during sintering of the ceramic becomes liquid due to its low melting point and then coats the particles of the basic material, thereby simplifying their densification. Any possible combination of the methods of Sternitzke and Reed would require that the powder produced be mixed with a silicate and then hot-pressed. Such a combination would be inappropriate for several reasons. In addition to requiring the hot-pressing step, a glassy phase in the abrasive itself is to be avoided since it would lower the abrasive capacity. The Action asserts that Reed suggests "abrasives" as a possible embodiment, however, it is most likely that the "grinding media" rather refers to ceramic abrasive wheels, the production of which uses silicate binders for keeping together the abrasives on the wheels. Furthermore, the effect of adding silicate to the sol at an early stage will have an unpredictable effect on the entire process, since between the sol state and sintering a series of chemical processes and conversions occur that might be affected by the silicate.

Sternitzke's process, in general, is directed to achieving a powder as an interim product, so that in any case (*i.e.*, with or without sinter additives) pressing will be a necessary step to achieve the pre-densification required for sintering. The presently claimed invention, however, produces compact and quite dense green bodies via the sol-gel-process that may then be sintered to abrasives without any pressing.

As discussed in the instant specification (paragraphs [0035-0036]), hot-pressing is an expensive and complex step which is considered unsuitable for mass, industrial production of abrasives. In contrast to such methods, "*the production of the abrasive grains according to the invention proceeds in hydrochemical fashion via a direct sol/gel route with the use of crystallization seeds...*", a method that requires no hot-pressing. The present invention extends the sintering ability of the dried and calcined gel by prior addition of α-Al_2O_3 crystals during the sol conditioning in order to make possible densification without any pressing by means of sintering, such as, for example, under inert conditions with a rotary tube. This advantageously simplifies the production process and reduces costs, thereby enabling an economically feasible mass production of Al_2O_3/SiC nanocomposite abrasives.

In addition to the points above, the method of the present invention yields abrasive grains with improved product characteristics, such as recited in claim 11, including a *hardness of > 16 GPa, a density of > 95% of the theory, and an SiC portion of between 0.1 and < 5 mol %, relative to the Al_2O_3 matrix, wherein the SiC particles are present in the Al_2O_3 matrix as well as intragranularly and the abrasive grain shows a performance factor LF_{25} > 75 % in the single-grain scratch test.* During hot-pressing, the hardness achieved is only 17.5 GPa (see Sternitzke, page 1066, par. 2.2.2), whereas abrasive grains produced by methods in accordance with the present invention achieve hardnesses of more than 19 GPa. The instant action asserts that a similar process would be expected to yield a nanocomposite with the claimed physical properties. As demonstrated above, however, the method of the present invention is quite distinguishable from the processes taught by Sternitzke and Reed, and therefore such an assumption relating to the physical properties is not justified. The simple combination of prior art in accordance with the traditional criteria set by any person skilled in the art is insufficient to develop the presently claimed abrasive material.

Thus, neither Sternitzke nor Reed, alone or in combination, teach the present invention as recited in amended, independent claims 1 and 11. Applicants respectfully request reconsideration and withdrawal of the rejections of these claims.

(c) Dependent claims 2-10 and 12-20

Claims 2-10 and 12-20 include all of the limitations of claim 1, as amended, or alternatively claim 11, as amended. As the patentability of claims 1 and 11 has been established above, it is respectfully submitted that claims 2-10 and 12-20 are similarly patentable over the cited combination and withdrawal of this ground for rejection is requested.

For at least the above noted reasons, Applicants respectfully submit that claims 1-20 are in a condition for allowance, and respectfully request that the Examiner reconsider and withdraw the outstanding rejections. Favorable consideration and allowance are earnestly solicited. Should there be any questions after reviewing this paper, the examiner is invited to contact the undersigned at 617-854-4000.

Respectfully submitted,
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